

Conservation and Transformation of Energy

PS-6 The student will demonstrate an understanding of the nature, conservation, and transformation of energy.

PS-6.3 Explain work in terms of the relationship among the force applied to an object, the displacement of the object, and the energy transferred to the object.

Taxonomy Level: 2.7-B Understand Conceptual Knowledge

Key Concepts:

Work: Force, Displacement

Energy, Joule

Previous/Future knowledge: In the 6th grade students recognize that energy is the ability to do work (force exerted over a distance) (6-5.6), and also explain how the design of simple machines (including levers, pulleys, and inclined planes) helps reduce the amount of force required to do work. (6-5.7). In Physical Science the students will expand their concept of work by explaining the relationship among force, displacement, work, and energy.

It is essential for the student to understand that

- *Work* is the product of the force applied to an object and the distance the object is moved in the direction of the force (displacement).
- Force and displacement are quantities that have magnitude (an amount or size) and direction. In order to do work on an object these conditions must apply:
 - A force is applied to the object.
 - The object must move in the direction of the force.
- When work is done on an object, energy is transferred to that object.
 - Work is equal to change in energy.
 - When a net force is applied to an object and the object moves, the work is transformed to kinetic energy.
 - If a greater force is added, or
 - If the force is applied over a greater distance, then the kinetic energy will be greater.
- If an object is lifted to some height, it gains gravitational potential energy equal to the work done against gravity in lifting the object.
 - The work done against gravity is the same whether the object was lifted straight up or rolled up a ramp.
 - The greater the height, the more gravitational potential energy the object has.
- The unit of measure for work and energy is the *joule*.

It is not essential for the student to solve problems involving kinetic energy change due to work.

Assessment Guidelines:

The objective of this indicator is to explain work, therefore, the primary focus of assessment should be to construct a cause and effect model that shows how a force applied in terms of direction, and distance, and size affects work and energy transformation. Assessments should require that students understand the relationships among force, distance, and energy change for gravitational potential energy as well as kinetic energy.

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In addition to *explain*, assessments may require that students

- Infer energy change when work is done on an object;
- Summarize work and energy change;
- Exemplify work done and resulting energy change;
- Illustrate situations where work is or is not done;
- Explain reasons why work is or is not done;
- Recall the definition of work.